of the problems presented by the former, they have received the larger share of attention and have ever attracted some of the most acute and philosophic of scientific workers. But while the researches of such investigators as Williamson and Renault into the actual structures and affinities of the carboniferous plants have been rewarded with the most brilliant successes, attempts to speculate and theorize have only been productive of barren controversy. All inferences as to the temperatures in which they flourished have merely been inductions from unknown data: their affinities with existing plants are so remote that they can tell us of little beyond moist climates and spongy, marshy soils, liable to inundation, with possibly an atmosphere more highly charged with carbonic acid than at present. But that neither the flora nor identical conditions were uniformly present over the whole land during the deposition of the carboniferous, becomes every year more apparent; and perhaps few would now maintain that fossil floras met with in widely-different latitudes must necessarily be contemporary because similar, or reject as impossible the correlation of the Glossopteris floras of the southern hemisphere simply because they are so dissimilar.

Tertiary floras, however, have to be approached from almost totally different standpoints, for here minute investigations into vegetable structure can only exceptionally lead to important results. On the other hand it may be possible to predicate the climate that any group among them would have required, with almost perfect accuracy. Allowing that even most closely-allied species may have had different habits, enough remain that are practically identical with living species. These not only prove to us that in every land in our hemisphere the temperatures remained warmer throughout the Tertiary period than at present, but also that the temperatures were far from equable during Eocene time. Thus it is impossible to hesitate as to the evidence of the flora in the lower stages of our Eocene, which exhibits an abundance of planes, poplars, and alders and an absence of all approach to sub-tropical essences; nor as to that of the London Clay, with its tropical nipas, sabals, and a host of others almost indistinguishable from species existing at the present day. There is scarcely need of the corroborative evidence of the Mollusca as to cooler seas in the Thanets, nor of tropical conditions in the large turtles, crocodiles, snakes, and nautili of Sheppey. In fact, the temperature of the spots occupied by Reading, Bournemouth, or Mull at a particular stage of the Eocene could be predicated from the fossil floras almost as accurately as from living plants. If the same cannot be said of the Arctic regions it is simply that the specimens brought home are, perhaps from the exigences of travel and inexperience of the collectors, for the most part so imperfectly preserved and fragmentary, that few of the determinations can carry the smallest weight. It may suit quidnuncs to accept indeterminable fragments as evidence of the growth of palms and cycads in the Greenland Eocene—it is time the Miocene age of these beds was relegated to the limbo of Coal-measure palms and yuccas—and to become excited over the presence of a sub-tropical flora within the Arctic circle; but as a fact it is doubtful whether anything has been discovered there which might not have grown in our own temperature, if slightly modified, a state of things which it is conceivable the damming back of the Arctic seas by the land connection which then existed between Europe and America, aided by an active Gulf Stream, might have brought about. When we come to the Miocene, worked out as that of Switzerland was by Heer, or still more the Quaternary, with such data as those laboriously amassed by Clement Reid, the inferences as to climate are still more irresistible.

As to evidence of the age of rocks, plants are less trustworthy, because they have neither been so perfectly studied nor are their zones as yet at all properly defined. All we can say is that certain assemblages are found in association at the beginning of the Tertiary, and that changing temperatures have since compelled them not to disperse, but to migrate far and wide. Fewer probably of the species are extinct than is generally supposed, and the primitive associations have held together perhaps to the present day, with many gaps from extinction and desertion and a large infusion of recruits through the ordinary causes of evolution, stimulated by the increase in browsing mammalia. Whether, on the other hand, the marine deposit zones are really entitled to the weight attached to them as evidences of age, except locally, is not so clear. They are usually the littoral deposits of a limited area, where some changes of level or current have apparently suddenly driven out the fauna and introduced new colonies more adapted to the changed conditions. If we could follow the subsequent wanderings of these assemblages under the sea our faith in their sudden extinction and consequently in their chronological value might be greatly modified. At all events, many of the less conspicuous groups of mollusca, when critically examined, prove to have surprisingly near relatives in distant seas at much later periods, and even at the present day.

J. STARKIE GARDNER.

OUR BOOK SHELF.

Pioneers of Science. By Oliver Lodge, F.R.S. (London and New York: Macmillan and Co., 1893.)

THIS book consists of eighteen lectures on the history and progress of astronomy, which were delivered by Dr. Lodge in 1887. "The lectures having been found interesting," he thought it "*natural* to write them out in full and publish," and, although this can scarcely be considered a sufficient excuse, the intrinsic merits of the work are abundant justification for its existence. In Part I., "From Dusk to Daylight," the progress of astronomy from Copernicus to Newton is traced in a series of vivid pictures of Copernicus, Tycho Brahe, Kepler, Galileo, Descartes, and Newton; while Part II., "A Couple of Centuries' Progress," brings the history of gravitational astronomy from Newton down to the present time. In these latter lectures Roemer and Bradley are associated with the velocity of light and aberration; Legrange and Laplace with the solar system and the nebular hypothesis; Herschel with the motion of "fixed" stars; Bessel with the distances of stars; Adams and Leverrier with the discovery of Neptune; and Lord Kelvin and George H. Darwin with tides. Dr. Lodge has been able, by judiciously combining clear statements of scientific facts and laws with interesting personal details, to give his lectures all the charm of a romance. The book is an admirable introduction to the study of astronomy, and no better gift for a beginner could well be chosen; while to those to whom many of

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its details are already familiar, the picturesque clearness with which they are presented will make their knowledge more real and more complete. The standard of excellence maintained in the lectures makes distinction difficult and invidious, or we would distinguish the lectures on Newton and those on tides as models of what such popular scientific expositions should be. The book is copiously, and, on the whole, well illustrated, but some of the illustrations—notably those of clusters and nebulæ—are very familiar and somewhat out of date. A curious mistake occurs on page 201, where a well-known drawing of a comet appears as an "old drawing of the Andromeda nebula." The illustration on page 326, showing the paths of Uranus and Neptune and their relative positions from 1781 to 1840, and professing "to illustrate the *direction* of their *mutual* perturbing forces," is partly misleading; but in introducing this Dr. Lodge has erred in good company, for the diagram, originally due to Dr. Houghton, appears in many of our recent astronomical text-books. A. T.

Electric Lighting and Power Distribution. Part I. By W. Perren Maycock, M.I.E.E. (London: Whittaker and Co., 1892.)

THIS cheap and useful little text-book has been written for the author's junior students, as he is of opinion that no trustworthy elementary work on the subject is to be obtained. The scope of the work has been limited to the syllabus of the ordinary grade examination of the City and Guilds of London Institute. We find, however, much information on subjects not usually found in other manuals. The book is freely illustrated, and the descriptions are clear.

It is very important for the junior student to understand clearly what is meant by a line of force, and to grasp the fact that lines of force are only *assumed* to exist, because, by such an assumption it is possible to explain many, otherwise inexplicable, phenomena. On page 47 we find the following statement:—"The power which any magnet possesses, of picking up pieces of iron, and of acting upon another magnet, depends upon the existence of lines of magnetic force." This quotation is vague; a junior student might easily imagine that the lines of force really existed, whereas they are purely assumptions, to elucidate the phenomena of magnetic attraction. The illustrations of simple bar magnets, solenoids, and electro-magnets, in which the lines of force are delineated, should have the assumed directions of the lines of force clearly shown by arrow-heads. This might be done with advantage in Figs. 17 to 20.

Chapter IV. deals with induction of currents, electromagnetic induction, Faraday's Law, and concludes with a clear description of magneto-motive force, magnetic resistance, magnetizing force, induction and permeability. These latter are very difficult for a junior student to understand thoroughly, and the author should have devoted more space to the discussion of these important points in dynamo construction. One particularly good feature in this text-book is the large number of questions arranged at the end of each chapter. These are well suited to test the knowledge of a student. Chapter V. deals generally with electrical testing, measuring instruments used in installations, and meters for measuring the current, such as Teague's, Elihu Thomson's, and the Wright-Ferrauti. Chapter VI. concludes the book, describing the principle of the dynamo, different types of machines, and the construction of the various parts.

Taken as a whole this book attempts too much. The matter described has suffered considerably by condensation, a serious thing where junior students are concerned. Most of the illustrations are good; some are indistinct, and Fig. 98 is decidedly wrong, showing the brushes set for one direction of rotation, and the arrow indicating the reverse.

On the other hand the sequence of matter is good, and a student should learn much from the work. The author takes great pains to describe clearly the many units involved, particularly the applications of Ohm's law. The book would last much longer in the hands of the average student if the present paper binding were replaced by something stronger.

The Naturalist on the River Amazons. By Henry Walter Bates, F.R.S. With a memoir of the author by Edward Clodd. Reprint of the Unabridged Edition. With Map and Numerous Illustrations. (London: John Murray, 1892.)

THIS work is so well known, and has long held so high a place among scientific books of travel, that it is unnecessary to do more than note the appearance of a new edition. It is clearly printed on good paper, and the illustrations are well reproduced. The introductory memoir by Mr. Clodd is a most welcome record of the main facts of Mr. Bates's career. The materials for this interesting sketch were enriched by letters placed at the author's disposal by Sir Joseph Hooker and Mr. Francis Darwin. An excellent portrait of Mr. Bates is included in the volume.

LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

A Proposed Handbook of the British Marine Fauna.

SUCH a handbook as Prof. Herdman suggests is so much wanted that many naturalists must from time to time have felt tempted to essay it. But the difficulties are very formidable. Prof. Herdman seems to contemplate the preparation of such a work mainly as a labour of compilation. But the groups where compilation would nearly suffice are just those where the handbook is least required. On the other hand, such a group as the Amphipoda, in spite of Canon Norman and Mr. Stebbing's many papers, is still in great need of revision; it was only the other day that Canon Norman opened our eyes to our rich fauna of Mysidæ, before which time no search among published records would have told us anything worth the having; we are in just the same position as to our British Cumacea, until Canon Norman again reveals the treasures of his cabinet; our Pycnogrns are almost as little known. In every one of these groups, and in many others like them, the preparation of a hand-list would need the experience of a specialist, just as much as the Tunicata would require Prof. Herdman's own special knowledge. The area to be embraced is another difficulty. Prof. Herdman proposes to take the British area as defined by "Canon Norman's" B.A. Committee in 1887, on which he himself served. But the committee's report was repudiated by Canon Norman himself, who afterwards suggested a wider "British area," whose boundaries I fancied had since been recognized as more suitable by everybody. However the British area be defined, there will long remain a difficulty in the numerous forms not yet recorded from within it, but which are likely, or certain, to turn up when sought for. Such things as the parasitic and other Crustacea described of late years by Giard and his pupils from Wimereux form a case in point. I am inclined to think that to make in the first instance a hand-list of the whole fauna of the North Atlantic basin would be not a bit more difficult, but in some respects easier, than to restrict the list to the British area alone. That it would be incomparably more useful is certain. It would make a book not more than three times (perhaps little more than twice) as big as Carus's "Fauna Mediterranea." And it would be a very important step towards that new *systema naturæ* of which the Germans are already beginning to talk, and which it is high time were begun.

But Prof. Herdman both asks discussion of his plan, and also invites criticism on his execution of it. Take his very first illustrative genus, which he tabulates as follows:—

ANTENNULARIA.—Stems simple or branched; pinnæ verticillate; nematophores along the stems; gonothecæ axillary, unilateral.

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